PATENT ABSTRACTS OF JAPAN

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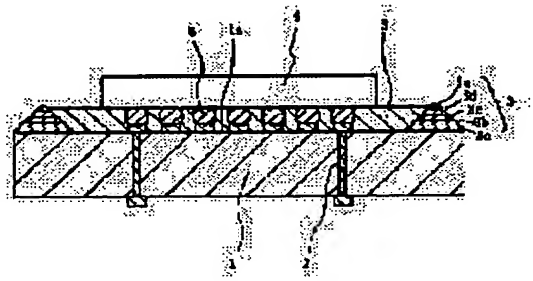
(54) WIRING BOARD FOR MOUNTING SEMICONDUCTOR ELEMENT AND SEMICONDUCTOR DEVICE USING THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To firmly secure a semiconductor element on an insulating base body with a resin filler, to satisfactory protect the element and also to bring the electrical connection of electrodes on the element with wiring conductors to a complete one and to stably actuate the element extending over a long period.
SOLUTION: This wiring board is a wiring board for mounting a semiconductor element, which has a mounting part 1a mounted with the semiconductor element 4 by a flip chip connection method and a frame-shape dam part 3 formed, in such a way as to encircle this mounting part 1a on an insulating base body 1, which is provided with wiring conductors 2 and consists of a ceramic. In this wiring board, the dam part 3 is formed by laminating a plurality of thick ceramic films layers 3a to 3e and the side surface on the inner side of the dam part 3 is formed into a step shape or a slant surface. Stress, which is applied to the bonded surface of the dam part 3 to a resin filler 5, is reduced satisfactorily and is dispersed by the side surface, which is formed into the step shape or the slant surface on the inner side of the dam part 3, and the generation of a separation between the dam part 3 and the filler 5 can be effectively prevented.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] wiring — the wiring substrate for semiconductor device loading with which it is the wiring substrate for semiconductor device loading which has the dam section of the shape of a frame by which it was formed on the insulating base which consists of the ceramics with which the conductor was arranged as the semiconductor device enclosed the loading section and this loading section carried by the flip-chip-bonding method, and said dam section carries out the laminating of the ceramic thick film of two or more layers, and changes, and the side face of the inside is characterized by stair-like or to be an inclined plane.
[Claim 2] Said ceramic thick film is a wiring substrate for semiconductor device loading according to claim 1 which consists of the ceramics of the same presentation substantially with said insulating base, and is characterized by the surface roughness being Ra>=0.65micrometer in the center line average of roughness height (Ra).
[Claim 3] wiring — with the wiring substrate for semiconductor device loading which has the dam section of the shape of a frame by which it was formed on the insulating base which consists of the ceramics with which the conductor was arranged as the semiconductor device enclosed the loading section and this loading section which are carried by the flip-chip-bonding method The semiconductor device carried in said loading section by the flip-chip-bonding method, It is the semiconductor device which consists of the filler made of resin filled up with the inside of said dam section between said insulating bases and said semiconductor devices, said dam section carries out the laminating of the ceramic thick film of two or more layers, it changes, and they are that the side face of the inside is stair-like, or the semiconductor device characterized by being an inclined plane.
[Claim 4] Said ceramic thick film is a semiconductor device according to claim 3 which consists of the ceramics of the same presentation substantially with said insulating base, and is characterized by the surface roughness being Ra>=0.65micrometer in the center line average of roughness height (Ra).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention — wiring — while carrying a semiconductor device in the wiring substrate for semiconductor device loading made as [carry / on the insulating base which has a conductor / by the flip-chip-bonding method / a semiconductor device], and this wiring substrate for semiconductor device loading by the flip-chip-bonding method, it is related with the semiconductor device which is filled up with the filler made of resin between a semiconductor device and an insulating base, and grows into it.
[0002]
[Description of the Prior Art] Recently as a semiconductor device corresponding to a miniaturization and thin-shape-izing of a computer etc. of electronic equipment For example, while having the loading section by which a semiconductor device is carried in the top-face center section of the insulating base which consists of ceramics, such as a nature sintered compact of an aluminum oxide, and the nature sintered compact of alumimium nitride, a nature sintered compact of a mullite, a nature sintered compact of silicon carbide, a nature sintered compact of silicon nitride, crystallized glass Prepare the wiring substrate for semiconductor device loading which a conductor is arranged and changes, and a semiconductor device is carried in the loading section of this wiring substrate for semiconductor device loading by the flip-chip-bonding method through the bump who consists of solder metallurgy etc. the inferior surface of tongue from that loading section — applying — wiring — While being filled up with the liquefied filler made of resin called under-filling between this semiconductor device and insulating base after an appropriate time, heat curing of this is carried out. While protecting a semiconductor device with this filler made of resin that heat-hardened, the semiconductor device which fixes an insulating base and a semiconductor device and changes is known.
[0003] In addition, the wiring substrate for semiconductor device loading in this semiconductor device is manufactured by the so-called ceramic green sheet laminated layers method. while performing specifically suitable punching processing for the ceramic green sheet which combines ceramic raw material powder with an organic binder, and changes — wiring — while carrying out printing spreading of the metal paste used as a conductor at a predetermined pattern and carrying out two or more sheet laminating of this ceramic green sheet, it is manufactured by calcinating at an elevated temperature.
[0004] However, after carrying a semiconductor device in the loading section of the wiring substrate for semiconductor device loading by the flip-chip-bonding method through the bump who consists of solder metallurgy according to this semiconductor device, From being filled up with the liquefied filler made of resin between an insulating base and a semiconductor device Liquefied filled resin flowed even into the part with the unnecessary filler made of resin on the insulating base with the fluidity, and there was a trouble that breadth and this had a bad influence on the function as a semiconductor device, or spoiled the appearance of a semiconductor device remarkably.
[0005] Then, in order to solve the above-mentioned trouble, as shown to drawing 3 in a sectional view wiring derived from loading section 11a by which a semiconductor device 12 is carried in the top-face center section of the insulating base 11 by the flip-chip-bonding method, and this loading section 11a on the inferior surface of tongue, while having a conductor 13 The wiring substrate for semiconductor device loading which has the dam section 14 of the shape of a frame of the predetermined height formed as enclosed this loading section 11a is prepared. A semiconductor device 12 is carried in loading section 11a of this wiring substrate for semiconductor device loading by the flip-chip-bonding method through the bump 15 who consists of solder metallurgy etc. Then, the liquefied filler 16 made of resin is filled up with the inside of the dam section 14 between an insulating base 11 and a semiconductor device 12, and the semiconductor device which is made to carry out heat curing of this, and changes is proposed.
[0006] If the liquefied filler 16 made of resin is filled up with the inside of the dam section 14 which encloses loading section 11a according to such a semiconductor device between an insulating base 11 and a semiconductor device 12, it will be effectively prevented by the dam section 14 that the liquefied filler 16 made of resin flows and spreads even into an unnecessary part.
[0007]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned wiring substrate for semiconductor device loading, the dam section 14 usually carries out the laminating of the ceramic green sheet pierced in the shape of a frame to the maximum upper layer of the layered product of the ceramic green sheet used as the wiring substrate for semiconductor device loading, and by calcinating it, it is formed so that loading section 11a may be surrounded.
[0008] Thus, the formed dam section 14 pierces a ceramic green sheet, and since it is formed by calcinating this, the side face of the inside serves as an abbreviation perpendicular to the top face of an insulating base 11.
[0009] And if the liquefied filler 16 made of resin is filled up with the inside of this dam section 14 between an insulating base 11 and a semiconductor device 12 and heat curing of this filler 16 made of resin is carried out, a big tensile stress will occur between the dam section 14 and the filler 16 made of resin by contracting, in case the filler 16 made of resin heat-hardens.
[0010] Furthermore, the coefficient of thermal expansion of the filler 16 made of resin is about 30x10-6-50x10-6/degree C to the coefficient of thermal expansion of the ceramics which forms an insulating base 11 being about 4x10-6-10x10-6/degree C. Since both coefficient of thermal expansion is greatly different, if a semiconductor device 12 is operated, it will originate in a difference of both coefficient of thermal expansion between an insulating base 11 and the filler 16 made of resin with the heat generated at the time of

the actuation, and big thermal stress will occur.
[0011] Such stress is superimposed mutually, acts to the plane of composition of the dam section 14 and the filler 16 made of resin, and generates exfoliation between the dam section 14 and the filler 16 made of resin from the upper limit section of the plane of composition of the dam section 14 and the filler 16 made of resin which are the part which this stress concentrates most. In addition, since the force in which the component to which the stress which acts between the dam section 14 and the filler 16 made of resin acts in the perpendicular direction to the plane of composition of the dam section 14 and the filler 16 made of resin tears off the dam section 14 and the filler 16 made of resin, so that it is large becomes large, the dam section 14 and the filler 16 made of resin become easy to exfoliate.
[0012] and — if exfoliation occurs between the dam section 14 and the filler 16 made of resin — the repeat of actuation of a semiconductor device 12, and a halt — following — this exfoliation — gradually — the core of an insulating base 11 — going — gradually — going on — just — being alike — the filler 16 made of resin exfoliated completely from the insulating base 11, and there was a trouble of it becoming impossible to protect a semiconductor device 12 good. moreover, the electrode of a semiconductor device 12 and wiring of the wiring substrate for semiconductor device loading — making exfoliation of the bumps 15 for connection, such as solder metallurgy which has joined the conductor 13, induce — the electrode of a semiconductor device 12, and wiring of an insulating base 11 — the electric connection with a conductor 13 was cut, consequently it had the trouble of it becoming impossible to operate a semiconductor device 12 to stability over a long period of time.
[0013] while this invention is thought out in view of the above-mentioned trouble, and the purpose makes an insulating base and a semiconductor device fix firmly with the filler made of resin and protecting a semiconductor device good — the electrode of a semiconductor device, and wiring — it is in offering the semiconductor device using the wiring substrate for semiconductor device loading and this as for which the electric connection with a conductor can operate a semiconductor device to stability over a long period of time as a perfect thing.
[0014]
[Means for Solving the Problem] the wiring substrate of this invention for semiconductor device loading — wiring — it is the wiring substrate for semiconductor device loading which has the dam section of the shape of a frame by which it was formed on the insulating base which consists of the ceramics with which the conductor was arranged as the semiconductor device enclosed the loading section carried by the flip-chip-bonding method , and this loading section , and said dam section carries out the laminating of the ceramic thick film of two or more layers , changes , and is that the side face of that inside is stair-like , or the thing characterized by to be an inclined plane .
[0015] moreover, the semiconductor device of this invention — wiring — on the insulating base which consists of the ceramics with which the conductor was arranged The wiring substrate for semiconductor device loading which has the frame-like dam section in which it was formed as the semiconductor device enclosed the loading section carried by the flip-chip-bonding method, and this loading section, It is the semiconductor device which consists of the semiconductor device carried in the loading section by the flip-chip-bonding method, and the filler made of resin filled up with the inside of the dam section between the insulating base and the semiconductor device. Said dam section carries out the laminating of the ceramic thick film of two or more layers, changes, and is that the side face of the inside is stair-like, or a thing characterized by being an inclined plane.
[0016] According to the wiring substrate for semiconductor device loading and semiconductor device of this invention, said dam section The laminating of the ceramic thick film of two or more layers is carried out, and it changes. The side face of the inside from stair-like or it being an inclined plane After carrying a semiconductor device in the loading section of an insulating base by the flip-chip-bonding method, The liquefied filler made of resin is filled up with the inside of the dam section between an insulating base and a semiconductor device. After carrying out heat curing of this, even if the stress by the heat which the stress and the semiconductor device by contraction at the time of hardening of the filler made of resin generate at the time of actuation is impressed between the dam section and the filler made of resin Since reduction distribution of the component which acts perpendicularly to the plane of composition of the dam section and the filler made of resin according to the side face inside the dam section used as an inclined plane is carried out good, it can prevent effectively that the stress is stair-like or that exfoliation occurs between the dam section and the filler made of resin.
[0017]
[Embodiment of the Invention] Next, the wiring substrate for semiconductor device loading and semiconductor device of this invention are explained to a detail based on an attached drawing.
[0018] Drawing 1 is the sectional view showing an example of the gestalt of the operation of a semiconductor device which used the wiring substrate for semiconductor device loading of this invention, and this. drawing 1 — setting — 1 — an insulating base and 2 — wiring — as for the dam section and 4, a conductor and 3 are [a semiconductor device and 5] the fillers made of resin. among these — an insulating base 1 and wiring — the wiring substrate for semiconductor device loading of this invention consists of a conductor 2 and the dam section 3, and the semiconductor device of this invention is constituted by this wiring substrate for semiconductor device loading, the semiconductor device 4, and the filler 5 made of resin.
[0019] Magnitude is the plate of the abbreviation square which is several several mm - cm angle extent, and the insulating base 1 is formed from ceramics, such as a nature sintered compact of an aluminum oxide, and the nature sintered compact of alumimium nitride, a nature sintered compact of a mullite, a nature sintered compact of silicon carbide, a nature sintered compact of silicon nitride, crystallized glass.
[0020] If this insulating base 1 is the case where it consists for example, of the nature sintered compact of an aluminum oxide While carrying out addition mixing of suitable organic binder and solvent for raw material powder, such as an aluminum oxide, oxidization silicon, magnesium oxide, and a calcium oxide, and making with the shape of slurry A ceramic green sheet is obtained by making this with the shape of a sheet by adopting the well-known doctor blade method conventionally. While performing suitable punching processing for this ceramic green sheet, it is manufactured by carrying out the laminating of two or more sheets if needed, and calcinating this raw ceramic object at the temperature of about 1600 degrees C among reducing atmosphere at a raw ceramic layered product, nothing, and the last.
[0021] An insulating base 1 functions as a support substrate for supporting a semiconductor device 4, and has loading section 1a for carrying a semiconductor device 4 in the top-face center section. A semiconductor device 4 is carried in this loading section 1a by the flip-chip-bonding method through the bump 6 who consists of solder metallurgy. In addition, semiconductor devices 4 are components

for electronic circuitries, such as an integrated circuit device currently formed from semiconductor materials, such as silicon and gallium arsenide.

[0022] and wiring which mentions this bump 6 later while loading to loading section 1a of a semiconductor device 4 makes the bump 6 who changes from solder metallurgy to each electrode for I/O formed in the active side of a semiconductor device 4 attach beforehand by joining or sticking by pressure — the part drawn to loading section 1a of a conductor 2 is made to contact, and it is carried out by joining both by joining or sticking by pressure.

[0023] wiring which changes from metal powder metallizing, such as a tungsten, and molybdenum, copper, silver, to loading section 1a of the insulating base 1 in which a semiconductor device 4 is carried — the end section of a conductor 2 — drawing — **** — this wiring — the other end of a conductor 2 is drawn on the inferior surface of tongue of an insulating base 1 through the interior of an insulating base 1.

[0024] this wiring — a conductor 2 functions as a track for connecting each electrode of a semiconductor device 4 to an external electrical circuit electrically, and as mentioned above, each electrode of a semiconductor device 4 is electrically connected to the part drawn to that loading section 1a through the bumps 6 for connection, such as solder metallurgy. moreover, wiring — the object for connection of an external electrical circuit substrate which does not illustrate the other end drawn on the inferior surface of tongue of the insulating base 1 of a conductor 2 — it will connect with a conductor through solder etc. and each electrode of a semiconductor device 4 will be connected to an external electrical circuit by this.

[0025] such wiring — if a conductor 2 is the case where it consists for example, of tungsten metallizing, as it derives from loading section 1a of an insulating base 1 to an inferior surface of tongue, the covering formation of it will be carried out at a predetermined pattern by adopting well-known screen printing as the ceramic green sheet which serves as an insulating base 1 in the metal paste which carried out addition mixing and obtained suitable organic binder and solvent for tungsten powder conventionally, carrying out printing spreading at a predetermined pattern, and calcinating this with a ceramic green sheet. in addition, wiring — the front face of a conductor 2 — usually — this wiring — while a conductor 2 prevents carrying out oxidization corrosion — wiring — connection with a conductor 2 and a bump 6, and wiring — the object for connection of the external electrical circuit substrate of a conductor 2 — in order to make connection through solder with a conductor an easy and firm thing, sequential covering of the nickel-plating film and the gilding film is carried out.

[0026] Moreover, after the filler 5 made of resin which consists of an epoxy resin is liquefied between an insulating base 1 and a semiconductor device 4 and is filled up into it with the inside of the dam section 3 later mentioned after carrying a semiconductor device 4 in loading section 1a of an insulating base 1 by the flip-chip-bonding method through a bump 6, heat curing is carried out and a semiconductor device is completed.

[0027] That thickness is dozens of micrometers - about hundreds of micrometers, and by filling up between an insulating base 1 and a semiconductor device 4, this filler 5 made of resin makes the operation which makes an insulating base 1 fix a semiconductor device 4 firmly while protecting a semiconductor device 4. Moreover, according to the specification of a semiconductor device, the various fillers of the sake on adjustment and the heat-conduction disposition of coefficient of thermal expansion may be contained.

[0028] In addition, what is necessary is just to perform restoration of the liquefied filler 6 made of resin of a between [an insulating base 1 and semiconductor devices 4] using a well-known dispenser conventionally. Moreover, what is necessary is just to perform heat curing of the filler 5 made of resin by heating to the temperature of 100 - 150 ** in oven etc.

[0029] Furthermore, as loading section 1a is surrounded in the top-face periphery section of an insulating base 1, the frame-like dam section 3 is formed in it.

[0030] A laminating is carried out and the dam section 3 changes so that the side face of the inside may become stair-like about the thick films 3a-3e of five layers which consist of ceramics, such as a nature sintered compact of an aluminum oxide, and the nature sintered compact of alumimium nitride, a nature sintered compact of a mullite, a nature sintered compact of silicon carbide, a nature sintered compact of silicon nitride, crystallized glass. And in case it is filled up with the liquefied filler 5 made of resin between an insulating base 1 and a semiconductor device 4 after carrying a semiconductor device 4 in loading section 1a of an insulating base 1 by the flip-chip-bonding method through a bump 6, the operation which prevents the liquefied filler 5 made of resin flowing even into a part with the unnecessary filler 5 made of resin on an insulating base 1 with the fluidity, and spreading is made.

[0031] This dam section 3 the ceramic thick films 3a-3e of five layers from carrying out a laminating and becoming so that the side face of the inside which is that inner skin may become stair-like A semiconductor device 4 is carried in loading section 1a of an insulating base 1 by the flip-chip-bonding method through a bump 6. After being filled up with the liquefied filler 5 made of resin between the insulating base 1 and the semiconductor device 4 and stiffening this, Even if the stress by the heat which the stress and the semiconductor device 4 by contraction at the time of hardening of the filler 5 made of resin generate at the time of actuation is impressed between the dam section 3 and the filler 5 made of resin Reduction distribution of the component which acts perpendicularly to the plane of composition of the dam section 3 and the filler 5 made of resin according to the side face inside the stair-like dam section 3 is carried out good, and, thereby, the stress can prevent effectively generating of exfoliation between the dam section 3 and the filler 5 made of resin.

[0032] The width of face is about 1-10mm, for example, and the height of the dam section 3 is 0.05 - 0.5 mm extent. And the thickness of each ceramic thick films 3a-3e is 10-100, respectively. It is mum grade. Moreover, what is necessary is just to set to about 0.01-1mm width of face of each stage formed in the side face of the inside.

[0033] In addition, if the dam section 3 sets the center line average of roughness height (Ra) of the front face to Ra>=0.65micrometer, it will become possible for the surface irregularity and the surface filler 5 made of resin of the dam section 3 to stop each other, and to join both of it still more firmly. Therefore, as for the dam section 3, what the center line average of roughness height (Ra) of the front face is set to Ra>=0.65micrometer for is desirable.

[0034] When this center line average of roughness height (Ra) is set to Ra>10micrometer, also as for the inclination which the part into which it is in the inclination it to become difficult to form the dam section 3 with the ceramic thick films 3a-3e, and irregularity with the detailed front face of the dam section 3 does not fully get wet with the resin filler 5 produces, what is set to Ra<=10micrometer is [the center line average of roughness height (Ra) of the front face of the dam section 3] on the other hand, desirable for a certain reason.

[0035] Furthermore, if the dam section 3 is substantially formed with the ceramics of the same presentation with the insulating base 1 Even if the coefficient of thermal expansion of an insulating base 1 and the dam section 3 serves as abbreviation identitas and the heat which a semiconductor device 4 generates at the time of actuation is repeatedly impressed to an insulating base 1 and the dam section

3 It can prevent effectively that the thermal stress resulting from a difference of a coefficient of thermal expansion does not occur among both, and exfoliation and a crack occur in the dam section 3. Therefore, as for the dam section 3, it is desirable to form with the ceramics of the same presentation substantially with an insulating base 1.

[0036] If such the dam section 3 is the case where each ceramic thick films 3a-3e consist of the nature sintered compact of an aluminum oxide The ceramic paste which carried out addition mixing and obtained suitable organic binder and solvent for raw material powder, such as an aluminum oxide, oxidization silicon, a calcium oxide, and magnesium oxide Carry out sequential printing and a laminating is carried out so that well-known screen printing may be conventionally adopted on the ceramic green sheet used as an insulating base 1 and it may become the pattern of the shape of a frame corresponding to each ceramic thick films 3a-3b. Covering formation is carried out by calcinating this with a ceramic green sheet at closure section 1b of the top face of an insulating base 1 at the shape of a predetermined frame.

[0037] In addition, while carrying out printing spreading of the ceramic paste with screen printing, since it will be easy to become coarse as compared with the insulating base 1 which calcinates a ceramic green sheet and is obtained, the surface roughness of the front face of the dam section 3 obtained by calcinating this can obtain easily the surface roughness set to Ra>=0.65micrometer by the center line average of roughness height (Ra).

[0038] Moreover, between that side face and top face becomes what originated in the surface tension of a ceramic paste and presented the radius of circle, and each ceramic paste used as each ceramic thick films 3a-3e printed on the ceramic green sheet used as an insulating base 1 can distribute the stress impressed to the plane of composition of the dam section 3 and the filler 5 made of resin also with this radius of circle good.

[0039] while the filler 5 made of resin flows, and does not spread into the unnecessary part on an insulating base 1 and being able to protect a semiconductor device 4 good with the filler 5 made of resin in this way according to the wiring substrate for semiconductor device loading and semiconductor device of this invention — the electrode of a semiconductor device 4, and wiring of an insulating base 1 — the electric connection with a conductor 2 can operate a semiconductor device 4 to stability over a long period of time as a perfect thing.

[0040] In addition, various modification is possible if this invention is range which is not limited to an example of the gestalt of above-mentioned operation, and does not deviate from the summary of this invention. For example, although the dam section 3 had the stair-like side face of the inside with an example of the gestalt of above-mentioned operation, the dam section 3 does not necessarily need to have the stair-like side face of the inside, for example, as shown to drawing 2 in an important section expanded sectional view, as for the dam section 3, the side face of the inside may be an inclined plane. Even if it is this case and the stress by the heat which the stress and the semiconductor device 4 by contraction at the time of hardening of the filler 5 made of resin generate at the time of actuation is impressed between the dam section 3 and the filler 5 made of resin Reduction distribution of the component which acts perpendicularly to the plane of composition of the dam section 3 and the filler 5 made of resin according to the side face inside the dam section 3 in which the stress serves as an inclined plane is carried out good, and it can prevent effectively that exfoliation occurs between the dam section 3 and the filler 5 made of resin by this. Such an inclined plane can be formed by adjusting suitably the thickness, width of face, and viscosity of a ceramic paste used as each ceramic thick films 3a-3e, in case screen printing is adopted on the ceramic green sheet which serves as an insulating base 1 in the ceramic paste used as each ceramic thick films 3a-3e which constitute the dam section 3 and sequential printing spreading is carried out.

[0041] Furthermore, although the dam section 3 was formed with an example of the gestalt of above-mentioned operation by carrying out the laminating of the ceramic thick films 3a-3e of five layers, the dam section 3 may be formed by carrying out the laminating of the ceramic thick film of 2-4 layers, and may be formed by carrying out the laminating of the ceramic thick film of six more or more layers.

[0042]

[Effect of the Invention] According to the wiring substrate for semiconductor device loading and semiconductor device of this invention, the dam section formed in the insulating base carries out the laminating of the ceramic thick film of two or more layers, and changes. That the side face of the inside is stair-like, or since it is an inclined plane, a semiconductor device is carried in the loading section of an insulating base by the flip-chip-bonding method. After filling up the liquefied filler made of resin with the inside of the dam section between the insulating base and the semiconductor device and carrying out heat curing of this, Even if the stress by the heat which the stress and the semiconductor device by contraction at the time of hardening of the filler made of resin generate at the time of actuation is impressed between the dam section and the filler made of resin That the stress is stair-like or since reduction distribution of the component which acts perpendicularly to the plane of composition of the dam section and the filler made of resin according to the side face inside the dam section used as an inclined plane is carried out good, Generating of exfoliation between the dam section and the filler made of resin can be prevented effectively. Consequently, while the filler made of resin flows, and does not spread into the unnecessary part on an insulating base and being able to protect a semiconductor device good with the filler made of resin the electrode of a semiconductor device, and wiring of an insulating base — it enables the electric connection with a conductor to operate a semiconductor device to stability over a long period of time as a perfect thing.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing an example of the gestalt of operation of the wiring substrate for semiconductor device loading of this invention, and the semiconductor device using this.
[Drawing 2] It is the important section expanded sectional view showing other examples of the gestalt of operation of the wiring substrate for semiconductor device loading of this invention, and the semiconductor device using this.
[Drawing 3] It is the sectional view of the conventional wiring substrate for semiconductor device loading, and the semiconductor device using this.
[Description of Notations]
1 .... Insulating base
1a .... Loading section
2 .... wiring — a conductor
3 .... Dam section
4 .... Semiconductor device
5 .... Filler made of resin

[Translation done.]

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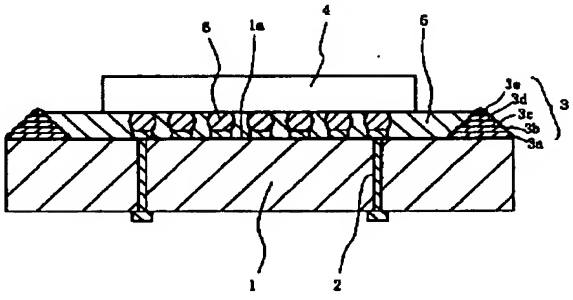
(54)【発明の名称】　半導体素子搭載用配線基板およびこれを用いた半導体装置

(57)【要約】
【課題】　熱応力により樹脂製充填材が絶縁基体から剥離して半導体素子を良好に保護することができず、半導体素子の電極と絶縁基体の配線導体との電気的な接続が切断されてしまう。
【解決手段】　配線導体２が配設されたセラミックスから成る絶縁基体１上に、半導体素子４がフリップチップ接続法により搭載される搭載部１ａおよびこの搭載部１ａを取り囲むようにして形成された枠状のダム部３を有する半導体素子搭載用配線基板であって、ダム部３は、複数層のセラミック厚膜３ａ～３ｅを積層して成り、その内側の側面が階段状または傾斜面となっている。階段状または傾斜面となっているダム部３の内側の側面により、ダム部３と樹脂製充填材５との接合面に印加される応力が良好に軽減分散され、ダム部３と樹脂製充填材５との間における剥離の発生を有効に防止できる。



1

【特許請求の範囲】

【請求項１】　配線導体が配設されたセラミックスから成る絶縁基体上に、半導体素子がフリップチップ接続法により搭載される搭載部および該搭載部を取り囲むようにして形成された枠状のダム部を有する半導体素子搭載用配線基板であって、前記ダム部は、複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることを特徴とする半導体素子搭載用配線基板。

【請求項２】　前記セラミック厚膜は、前記絶縁基体と実質的に同じ組成のセラミックスから成り、その表面粗さが中心線平均粗さ（Ｒａ）でＲａ≧0.65μｍであることを特徴とする請求項１記載の半導体素子搭載用配線基板。

【請求項３】　配線導体が配設されたセラミックスから成る絶縁基体上に、半導体素子がフリップチップ接続法により搭載される搭載部および該搭載部を取り囲むようにして形成された枠状のダム部を有する半導体素子搭載用配線基板と、前記搭載部にフリップチップ接続法により搭載された半導体素子と、前記ダム部の内側で前記絶縁基体と前記半導体素子との間に充填された樹脂製充填材とから成る半導体装置であって、前記ダム部は、複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることを特徴とする半導体装置。

【請求項４】　前記セラミック厚膜は、前記絶縁基体と実質的に同じ組成のセラミックスから成り、その表面粗さが中心線平均粗さ（Ｒａ）でＲａ≧0.65μｍであることを特徴とする請求項３記載の半導体装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、配線導体を有する絶縁基体上に半導体素子をフリップチップ接続法により搭載するようになした半導体素子搭載用配線基板およびこの半導体素子搭載用配線基板に半導体素子をフリップチップ接続法により搭載するとともに半導体素子と絶縁基体との間に樹脂製充填材を充填して成る半導体装置に関するものである。

【０００２】

【従来の技術】近時、コンピュータ等の電子機器の小型化や薄型化に対応した半導体装置として、例えば酸化アルミニウム質焼結体や窒化アルミニウム質焼結体・ムライト質焼結体・炭化珪素質焼結体・窒化珪素質焼結体・ガラスセラミックス等のセラミックスから成る絶縁基体の上面中央部に半導体素子が搭載される搭載部を有するとともにその搭載部から下面にかけて配線導体が配設されて成る半導体素子搭載用配線基板を準備し、この半導体素子搭載用配線基板の搭載部に半導体素子を半田や金等から成るバンプを介してフリップチップ接続法により搭載して、しかる後、この半導体素子と絶縁基体との間

2

にアンダーフィルと呼ばれる液状の樹脂製充填材を充填するとともにこれを熱硬化させ、この熱硬化した樹脂製充填材により半導体素子を保護するとともに絶縁基体と半導体素子とを固着して成る半導体装置が知られている。

【０００３】なお、この半導体装置における半導体素子搭載用配線基板は、いわゆるセラミックグリーンシート積層法によって製作されている。具体的には、セラミックス原料粉末を有機バインダで結合して成るセラミックグリーンシートに適当な打ち抜き加工を施すとともに配線導体となる金属ペーストを所定のパターンに印刷塗布し、このセラミックグリーンシートを複数枚積層するとともに高温で焼成することによって製作されている。

【０００４】しかしながら、この半導体装置によると、半導体素子搭載用配線基板の搭載部に半導体素子を半田や金から成るバンプを介してフリップチップ接続法により搭載した後、絶縁基体と半導体素子との間に液状の樹脂製充填材を充填することから、充填した液状の樹脂がその流動性により絶縁基体上で樹脂製充填材が不要な部分にまで流れ広がり、これが半導体装置としての機能に悪影響を及ぼしたり、半導体装置の外観を著しく損ねたりするという問題点があった。

【０００５】そこで、上記問題点を解決するために、図３に断面図で示すように、絶縁基体11の上面中央部に半導体素子12がフリップチップ接続法により搭載される搭載部11a およびこの搭載部11a から下面に導出する配線導体13を有するとともに、この搭載部11a を取り囲むようにして形成された所定高さの枠状のダム部14を有する半導体素子搭載用配線基板を準備し、この半導体素子搭載用配線基板の搭載部11ａに半導体素子12を半田や金等から成るバンプ15を介してフリップチップ接続法により搭載し、その後、ダム部14の内側で絶縁基体11と半導体素子12との間に液状の樹脂製充填材16を充填し、これを熱硬化させて成る半導体装置が提案されている。

【０００６】このような半導体装置によると、搭載部11ａを取り囲むダム部14の内側で絶縁基体11と半導体素子12との間に液状の樹脂製充填材16を充填すると、液状の樹脂製充填材16が不要な部分にまで流れ広がるのがダム部14により有効に防止される。

【０００７】

【発明が解決しようとする課題】しかしながら、上述の半導体素子搭載用配線基板においては、ダム部14は通常、枠状に打ち抜いたセラミックグリーンシートを半導体素子搭載用配線基板となるセラミックグリーンシートの積層体の最上層に積層し、それを焼成することによって搭載部11a を取り囲むように形成されている。

【０００８】このようにして形成されたダム部14は、セラミックグリーンシートを打ち抜き、これを焼成することにより形成されていることから、その内側の側面が絶縁基体11の上面に対して略垂直となっている。

【０００９】そして、このダム部14の内側で絶縁基体11と半導体素子12との間に液状の樹脂製充填材16を充填してこの樹脂製充填材16を熱硬化させると、樹脂製充填材16が熱硬化する際に収縮することによりダム部14と樹脂製充填材16との間に大きな引っ張り応力が発生する。

【００１０】さらに、絶縁基体11を形成するセラミックスの熱膨張係数が４×10⁻⁶～10×10⁻⁶／℃程度であるのに対して樹脂製充填材16の熱膨張係数が30×10⁻⁶～50×10⁻⁶／℃程度であり、両者の熱膨張係数が大きく相違することから、半導体素子12を作動させると、その作動時に発生する熱により絶縁基体11と樹脂製充填材16との間に両者の熱膨張係数の相違に起因して大きな熱応力が発生する。

【００１１】このような応力は、互いに重畳してダム部14と樹脂製充填材16との接合面に対して作用し、この応力が最も集中する部位であるダム部14と樹脂製充填材16との接合面の上端部からダム部14と樹脂製充填材16との間に剥離を発生させる。なお、ダム部14と樹脂製充填材16との間に作用する応力は、ダム部14と樹脂製充填材16との接合面に対して垂直な方向に作用する成分が大きい程、ダム部14と樹脂製充填材16とを引き剥がす力が大きくなるのでダム部14と樹脂製充填材16とが剥離しやすくなる。

【００１２】そして、ダム部14と樹脂製充填材16との間に剥離が発生すると、半導体素子12の作動および停止の繰り返しに伴って、この剥離が次第に絶縁基体11の中心部に向かって徐々に進行していき、ついには樹脂製充填材16が絶縁基体11から完全に剥離してしまい、半導体素子12を良好に保護することができなくなってしまうという問題点があった。また、半導体素子12の電極と半導体素子搭載用配線基板の配線導体13とを接合している半田や金等の接続用バンプ15の剥離を誘発させることによって、半導体素子12の電極と絶縁基体11の配線導体13との電気的な接続が切断され、その結果、半導体素子12を長期間にわたり安定に作動させることができなくなってしまうという問題点を有していた。

【００１３】本発明は上記問題点に鑑み案出されたものであり、その目的は、絶縁基体と半導体素子とを樹脂製充填材により強固に固着させ、半導体素子を良好に保護するとともに半導体素子の電極と配線導体との電気的な接続を完全なものとして半導体素子を長期間にわたり安定に作動させることができる半導体素子搭載用配線基板およびこれを用いた半導体装置を提供することにある。

【００１４】

【課題を解決するための手段】本発明の半導体素子搭載用配線基板は、配線導体が配設されたセラミックスから成る絶縁基体上に、半導体素子がフリップチップ接続法により搭載される搭載部およびこの搭載部を取り囲むようにして形成された枠状のダム部を有する半導体素子搭載用配線基板であって、前記ダム部は、複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることを特徴とするものである。

【００１５】また、本発明の半導体装置は、配線導体が配設されたセラミックスから成る絶縁基体上に、半導体素子がフリップチップ接続法により搭載される搭載部およびこの搭載部を取り囲むようにして形成された枠状のダム部を有する半導体素子搭載用配線基板と、搭載部にフリップチップ接続法により搭載された半導体素子と、ダム部の内側で絶縁基体と半導体素子との間に充填された樹脂製充填材とから成る半導体装置であって、前記ダム部は、複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることを特徴とするものである。

【００１６】本発明の半導体素子搭載用配線基板および半導体装置によれば、前記ダム部は、複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることから、絶縁基体の搭載部に半導体素子をフリップチップ接続法により搭載した後、ダム部の内側で絶縁基体と半導体素子との間に液状の樹脂製充填材を充填し、これを熱硬化させた後、樹脂製充填材の硬化時の収縮による応力や半導体素子が作動時に発生する熱による応力がダム部と樹脂製充填材との間に印加されたとしても、その応力は階段状または傾斜面となっているダム部の内側の側面によりダム部と樹脂製充填材との接合面に対して垂直方向に作用する成分が良好に低減分散されるため、ダム部と樹脂製充填材との間に剥離が発生することを有効に防止することができる。

【００１７】

【発明の実施の形態】次に、本発明の半導体素子搭載用配線基板および半導体装置について添付の図面を基にして詳細に説明する。

【００１８】図１は、本発明の半導体素子搭載用配線基板およびこれを用いた半導体装置の実施の形態の一例を示す断面図である。図１において、１は絶縁基体、２は配線導体、３はダム部、４は半導体素子、５は樹脂製充填材である。これらのうち、絶縁基体１と配線導体２とダム部３とで本発明の半導体素子搭載用配線基板が構成されており、この半導体素子搭載用配線基板と半導体素子４および樹脂製充填材５とにより本発明の半導体装置が構成されている。

【００１９】絶縁基体１は、例えば大きさが数ｍｍ～数ｃｍ角程度の略四角形の平板であり、酸化アルミニウム質焼結体や窒化アルミニウム質焼結体・ムライト質焼結体・炭化珪素質焼結体・窒化珪素質焼結体・ガラスセラミックス等のセラミックスから形成されている。

【００２０】この絶縁基体１は、例えば酸化アルミニウム質焼結体から成る場合であれば、酸化アルミニウム・酸化珪素・酸化マグネシウム・酸化カルシウム等の原料粉末に適当な有機バインダ・溶剤を添加混合して泥漿状となすとともに、これを従来周知のドクタブレード法を

採用することによってシート状となすことによりセラミックグリーンシートを得、このセラミックグリーンシートに適当な打ち抜き加工を施すとともに必要に応じて複数枚を積層して生セラミック積層体となし、最後にこの生セラミック体を還元雰囲気中、約1600℃の温度で焼成することによって製作される。

【００２１】絶縁基体１は、半導体素子４を支持するための支持基板として機能し、その上面中央部に半導体素子４を搭載するための搭載部１ａを有している。この搭載部１ａには半導体素子４が半田や金から成るバンプ６を介してフリップチップ接続法により搭載される。なお、半導体素子４は、例えばシリコンやガリウム砒素等の半導体材料から形成されている集積回路素子等の電子回路用素子である。

【００２２】そして半導体素子４の搭載部１ａへの搭載は、半導体素子４の能動面に形成された入出力用の各電極に半田や金から成るバンプ６を溶着や圧着により予め取着させておくとともにこのバンプ６を後述する配線導体２の搭載部１ａに導出した部位に当接させ、両者を溶着や圧着により接合することによって行なわれる。

【００２３】半導体素子４が搭載される絶縁基体１の搭載部１ａにはタングステンやモリブデン・銅・銀等の金属粉末メタライズから成る配線導体２の一端部が導出しており、この配線導体２の他端部は絶縁基体１の内部を介して絶縁基体１の下面に導出している。

【００２４】この配線導体２は半導体素子４の各電極を外部電気回路に電気的に接続するための導電路として機能し、上述したように、その搭載部１ａに導出した部位には半導体素子４の各電極が半田や金等の接続用バンプ６を介して電気的に接続される。また、配線導体２の絶縁基体１の下面に導出した他端部は、図示しない外部電気回路基板の接続用導体に半田等を介して接続され、これによって、半導体素子４の各電極が外部の電気回路に接続されることとなる。

【００２５】このような配線導体２は、例えばタングステンメタライズから成る場合であれば、タングステン粉末に適当な有機バインダ・溶剤を添加混合して得た金属ペーストを絶縁基体１となるセラミックグリーンシートに従来周知のスクリーン印刷法を採用して所定のパターンに印刷塗布し、これをセラミックグリーンシートとともに焼成することによって、絶縁基体１の搭載部１ａから下面に導出するようにして所定のパターンに被着形成される。なお、配線導体２の表面には、通常、この配線導体２が酸化腐食するのを防止するとともに配線導体２とバンプ６との接続および配線導体２の外部電気回路基板の接続用導体との半田を介した接続を容易かつ強固なものとするために、ニッケルめっき膜および金めっき膜が順次被着されている。

【００２６】また、絶縁基体１の搭載部１ａに半導体素子４をバンプ６を介してフリップチップ接続法により搭載した後は、後述するダム部３の内側で絶縁基体１と半導体素子４との間に例えばエポキシ樹脂から成る樹脂製充填材５が液状で充填された後、熱硬化されて半導体装置が完成する。

【００２７】この樹脂製充填材５は、その厚さが例えば数十μｍ～数百μｍ程度であり、絶縁基体１と半導体素子４との間に充填されることにより、半導体素子４を保護するとともに半導体素子４を絶縁基体１に強固に固着させる作用をなす。また、半導体装置の仕様に応じて、熱膨張率の調整や熱伝導性向上のための各種フィラーを含有してもよい。

【００２８】なお、絶縁基体１と半導体素子４との間への液状の樹脂製充填材６の充填は、例えば従来周知のディスペンサを用いて行なえばよい。また、樹脂製充填材５の熱硬化は、例えばオーブン等により100 ～150 ℃の温度に加熱することにより行なえばよい。

【００２９】さらに、絶縁基体１の上面外周部には、搭載部１ａを取り囲むようにして枠状のダム部３が形成されている。

【００３０】ダム部３は、例えば酸化アルミニウム質焼結体や窒化アルミニウム質焼結体・ムライト質焼結体・炭化珪素質焼結体・窒化珪素質焼結体・ガラスセラミックス等のセラミックスから成る５層の厚膜３ａ～３ｅをその内側の側面が階段状となるように積層して成る。そして、絶縁基体１の搭載部１ａに半導体素子４をバンプ６を介してフリップチップ接続法により搭載した後、絶縁基体１と半導体素子４との間に液状の樹脂製充填材５を充填する際に、液状の樹脂製充填材５がその流動性により絶縁基体１上で樹脂製充填材５が不要な部分にまで流れ広がるのを防止する作用をなす。

【００３１】このダム部３は、例えば５層のセラミック厚膜３ａ～３ｅをその内周面である内側の側面が階段状となるように積層してなることから、絶縁基体１の搭載部１ａに半導体素子４をバンプ６を介してフリップチップ接続法により搭載し、絶縁基体１と半導体素子４との間に液状の樹脂製充填材５を充填してこれを硬化させた後、樹脂製充填材５の硬化時の収縮による応力や半導体素子４が作動時に発生する熱による応力がダム部３と樹脂製充填材５との間に印加されたとしても、その応力は階段状となっているダム部３の内側の側面によりダム部３と樹脂製充填材５との接合面に対して垂直方向に作用する成分が良好に低減分散され、これによりダム部３と樹脂製充填材５との間における剥離の発生を有効に防止することができる。

【００３２】ダム部３は、例えばその幅が１～10ｍｍ程度であり、その高さが0.05～0.5 ｍｍ程度である。そして、各セラミック厚膜３ａ～３ｅの厚みは、それぞれ10～100 μｍ程度である。また、その内側の側面に形成される各段の幅は0.01～１ｍｍ程度としておけばよい。

【００３３】なお、ダム部３は、その表面の中心線平均

粗さ（Ｒａ）をＲａ≧0.65μｍとしておくと、ダム部３の表面の凹凸と樹脂製充填材５とが係止し合って両者をさらに強固に接合させることが可能となる。したがって、ダム部３は、その表面の中心線平均粗さ（Ｒａ）をＲａ≧0.65μｍとしておくことが好ましい。

【００３４】一方、この中心線平均粗さ（Ｒａ）がＲａ＞10μｍとなると、ダム部３をセラミック厚膜３ａ～３ｅで形成することが困難となる傾向にあり、またダム部３の表面の微細な凹凸が樹脂性充填材５で十分に濡れない部分が生じる傾向もあるため、ダム部３の表面の中心線平均粗さ（Ｒａ）はＲａ≦10μｍとしておくことが好ましい。

【００３５】さらに、ダム部３は、絶縁基体１と実質的に同じ組成のセラミックスで形成しておくと、絶縁基体１とダム部３との熱膨張係数が略同一となり、絶縁基体１とダム部３とに例えば半導体素子４が作動時に発生する熱が繰り返し印加されたとしても、両者間に熱膨張係数の相違に起因する熱応力が発生することはなく、ダム部３に剥離やクラックが発生することを有効に防止できる。従って、ダム部３は絶縁基体１と実質的に同じ組成のセラミックスで形成することが好ましい。

【００３６】このようなダム部３は、例えば各セラミック厚膜３ａ～３ｅが酸化アルミニウム質焼結体から成る場合であれば、酸化アルミニウム・酸化珪素・酸化カルシウム・酸化マグネシウム等の原料粉末に適当な有機バインダ・溶剤を添加混合して得たセラミックペーストを、絶縁基体１となるセラミックグリーンシート上に従来周知のスクリーン印刷法を採用して各セラミック厚膜３ａ～３ｂに対応した枠状のパターンとなるように順次印刷して積層し、これをセラミックグリーンシートとともに焼成することによって絶縁基体１の上面の封止部１ｂに所定の枠状に被着形成される。

【００３７】なお、セラミックペーストをスクリーン印刷法により印刷塗布するとともに、これを焼成することによって得られるダム部３の表面の表面粗さは、セラミックグリーンシートを焼成して得られる絶縁基体１と比較して粗いものとなりやすいため、中心線平均粗さ（Ｒａ）でＲａ≧0.65μｍとなる表面粗さを容易に得ることができる。

【００３８】また、絶縁基体１となるセラミックグリーンシート上に印刷された各セラミック厚膜３ａ～３ｅとなる各セラミックペーストは、その側面と上面との間がセラミックペーストの表面張力に起因して丸みを呈したものとなり、この丸みによってもダム部３と樹脂製充填材５との接合面に印加される応力を良好に分散することができる。

【００３９】かくして、本発明の半導体素子搭載用配線基板および半導体装置によれば、樹脂製充填材５が絶縁基体１上の不要な部分に流れ広がることがなく、かつ半導体素子４を樹脂製充填材５により良好に保護することができるとともに、半導体素子４の電極と絶縁基体１の配線導体２との電気的な接続を完全なものとして半導体素子４を長期間にわたり安定に作動させることができる。

【００４０】なお、本発明は上述の実施の形態の一例に限定されるものではなく、本発明の要旨を逸脱しない範囲であれば種々の変更は可能である。例えば、上述の実施の形態の一例ではダム部３はその内側の側面が階段状となっていたが、ダム部３は必ずしもその内側の側面が階段状となっている必要はなく、例えば図２に要部拡大断面図で示すように、ダム部３はその内側の側面が傾斜面となっていてもよい。この場合であっても、樹脂製充填材５の硬化時の収縮による応力や半導体素子４が作動時に発生する熱による応力がダム部３と樹脂製充填材５との間に印加されたとしても、その応力は傾斜面となっているダム部３の内側の側面によりダム部３と樹脂製充填材５との接合面に対して垂直方向に作用する成分が良好に低減分散され、これによりダム部３と樹脂製充填材５との間に剥離が発生することを有効に防止することができる。このような傾斜面は、ダム部３を構成する各セラミック厚膜３ａ～３ｅとなるセラミックペーストを絶縁基体１となるセラミックグリーンシート上にスクリーン印刷法を採用して順次印刷塗布する際に、各セラミック厚膜３ａ～３ｅとなるセラミックペーストの厚みと幅ならびに粘度を適宜調整することによって形成可能である。

【００４１】さらに、上述の実施の形態の一例ではダム部３は５層のセラミック厚膜３ａ～３ｅを積層することによって形成されていたが、ダム部３は２～４層のセラミック厚膜を積層することによって形成されていてもよいし、さらには６層以上のセラミック厚膜を積層することによって形成されていてもよい。

【００４２】

【発明の効果】本発明の半導体素子搭載用配線基板および半導体装置によれば、絶縁基体に形成されたダム部が複数層のセラミック厚膜を積層して成り、その内側の側面が階段状または傾斜面となっていることから、絶縁基体の搭載部に半導体素子をフリップチップ接続法により搭載し、ダム部の内側で絶縁基体と半導体素子との間に液状の樹脂製充填材を充填してこれを熱硬化させた後、樹脂製充填材の硬化時の収縮による応力や半導体素子が作動時に発生する熱による応力がダム部と樹脂製充填材との間に印加されたとしても、その応力は階段状または傾斜面となっているダム部の内側の側面によりダム部と樹脂製充填材との接合面に対して垂直方向に作用する成分が良好に低減分散されるため、ダム部と樹脂製充填材との間における剥離の発生を有効に防止することができ、その結果、樹脂製充填材が絶縁基体上の不要な部分に流れ広がることがなく、かつ半導体素子を樹脂製充填材により良好に保護することができるとともに、半導体

素子の電極と絶縁基体の配線導体との電気的な接続を完全なものとして半導体素子を長期間にわたり安定に作動させることが可能となる。

【図面の簡単な説明】

【図１】本発明の半導体素子搭載用配線基板およびこれを用いた半導体装置の実施の形態の一例を示す断面図である。

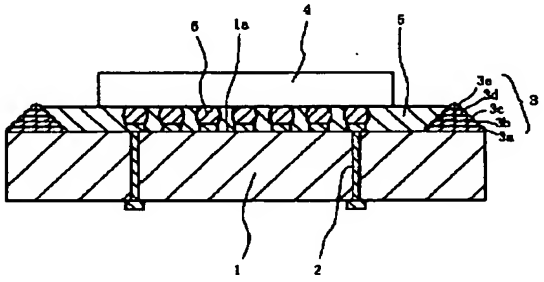
【図２】本発明の半導体素子搭載用配線基板およびこれを用いた半導体装置の実施の形態の他の例を示す要部拡大断面図である。

＊【図３】従来の半導体素子搭載用配線基板およびこれを用いた半導体装置の断面図である。

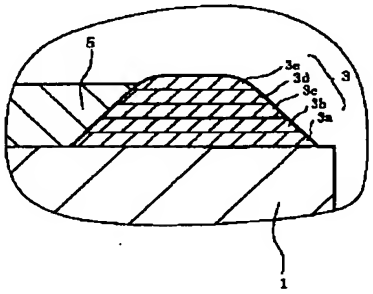
【符号の説明】

１・・・・絶縁基体
１ａ・・・・搭載部
２・・・・配線導体
３・・・・ダム部
４・・・・半導体素子
５・・・・樹脂製充填材

【図１】



【図２】



【図３】